Menlo Park Notebook #1 [N-78-11-28]

This notebook covers the period November 1878-July 1879. Most of the entries are by Edison, Charles Batchelor, and Francis Upton. There are also entries by George E. Carman and George Jackson. The names of Martin Force and John Ott appear occasionally as witnesses. Almost all of the material relates to experiments on electric lighting. Included are notes and drawings of lamps; notes on materials for filaments; drawings of devices for producing and testing filaments; notes, drawings, and calculations about generators; notes by Edison on gas use in San Francisco; and drawings of arc lamps. There are also notes on batteries made and tested, notes on carbon button tests, and notes and drawings of telephones. The book contains 274 numbered pages.

Blank pages not filmed: 240-241, 258-261, 270-273.

Missing page numbers: 264-265, 268-269.

M01

12 1/2

752
45
3760
3008
33840

LIBRARY OF THE
BOARD OF PATENT CONTROL,
120 BROADWAY, NEW YORK.
~~GENERAL ELECTRIC.~~
, 189

7500

⓪ feet Nov 28 1878

TAE

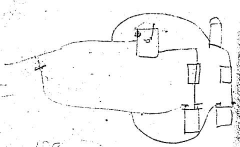
Sautrian uses 500,000,000 per year if this was burned in burners consuming 5 feet per hour ~~etc~~ 10 hours per day ~~then~~ 1 burner 20 days per 1000 or 500 burners. 20 days. 1,000,000. feet would [illegible] 1000 burners, or 500 000 jets would burn up the entire [illegible] in 20 days, or 250 000 in 40 125 000 in 80. 62,500. in 160, 31,250. burners in 320 days, never I think there is 90,000, burners in use,

~~10~~ ~~500~~ 5) 1500,000 day
6) 300,000
50
200,000
2
300 100,000
100

MO1

12 1/2

752
45
3760
3008
33840



750
5
3750
3750
7500

O Books Nov 28 1878

TAE

Sautran uses 500,000,000 per year

if this was burned in burners

Consuming 5 feet per hour,

10 hours per day then

1 burner

burner in day

5) 1,500,000

6) 300,000

50

2 100,000

100

15/188
128 8/15
60
720
32
752

15/480
32

Nov 28. 1878.

~~10000~~)1500000.
150,000.
9
1,350,000

~~169~~000
~~188~~000

170.000,
Tar

10

200

100 Ton 1 hour
50 2
25 4
12 ½ 8

25

500

10 [illegible]

170 Tons.
5
850
80
93

170
4
680.

102
[illegible].

12 1

9/500 000.000
56,666

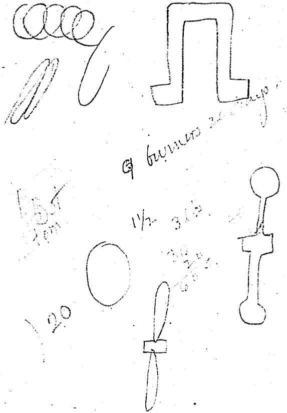
5 100

56
9
514

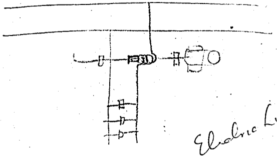
50 000
56
[illegible]

Nov 28. 1878

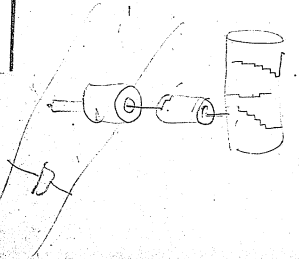
TAE

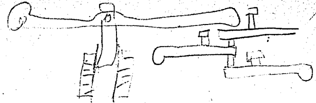

9 burners 22 cp
1½ 3 16
120

Nov 30 1878
T A Edison

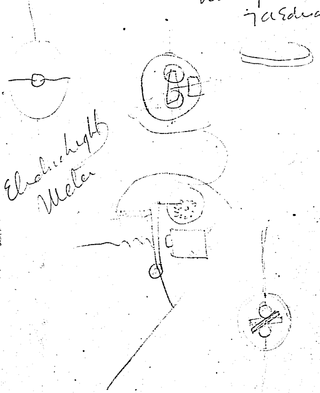


Electric Light Meter





Nov 29 1878
TA Edison



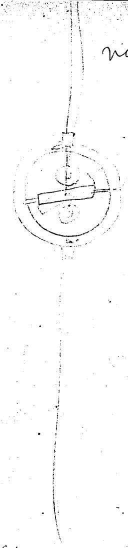
Electric light
Meter

Nov 29, 78

See Pat. 242,901 & Pat. 222,112 W.J.H

Nov 29, 78

TA Edison

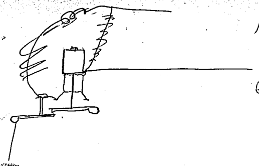


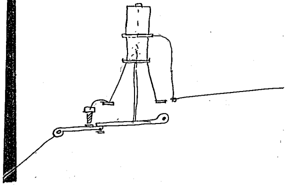
See Pat. 242,901 + Pat. 222,112
W.J.H

NOV 29 78

T.A.E

Chas Batchelor



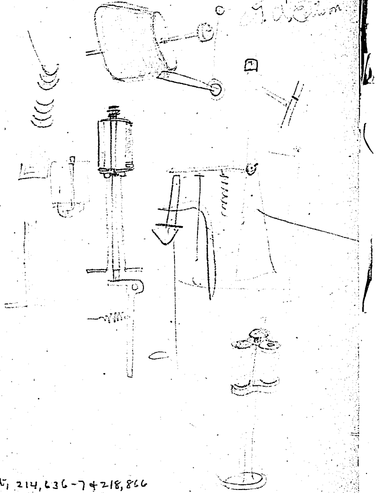


100.

1	1
2	.50
4	25
8	12½
	6¼
16	

Dec 6 1878.

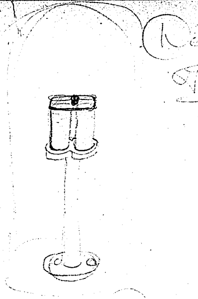
T. A. Edison



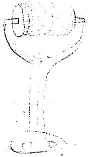
Pat, 214,636-7 & 218,866

Dec 6 1878

TAE



Pedestal [illegible]



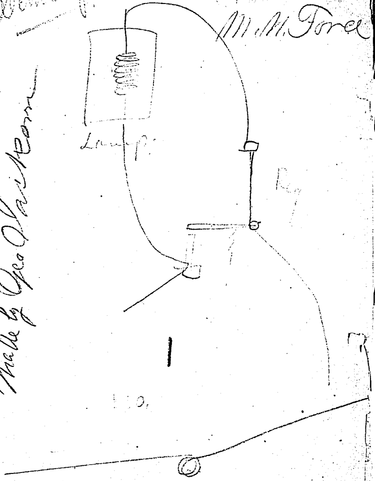
See Pat. 214,636-7-+ 218,866

Electric Light

Dec 6 1878
Chas Batchelor

M. M. Force

Made by Geo Carman



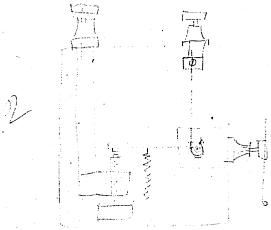
110.

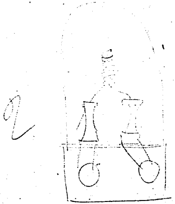
See Pats 214,636 - 214,637 - 218,866 N.J.H.

Electric Light Dec 7 1878

Chas Batchelor

Make by Geo Jackson





See Pats 214,636 - 214,637 - 218,866 W.J.H.

Electric Light

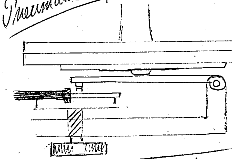
Pneumatic Regulator

Dec 9th 1878

Chas Batchelor

John F Ott

TAE



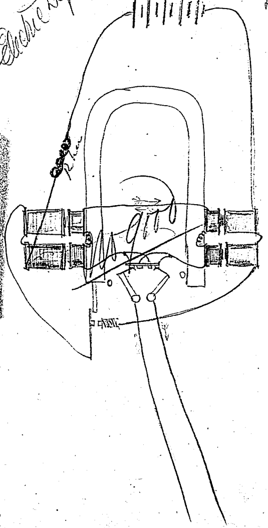
Shorten the Chamber & put lever in place of Spring

See Pats 214.636 – 214,637 – 218.866 W.J.H

Electric Light

Dec 15 1876

TAE



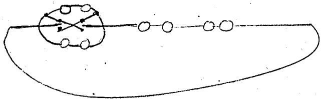
see Pat- # 218,166 W.J.H

Dec 15 1878

Fork Magnets

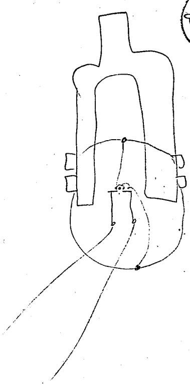
Chas Batchelor

TAE



See Pat. 218,166 W.J.H.

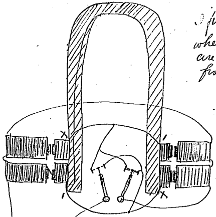
Dec 15 1878



see Pat. 218,166 W.J.H.

Electric Light

Dec 15th 1878
Chas Batchelor
TAE



I find most current when induction magnet are connected together from X to X & 1 to 1

We got a very slight current owing to the magnets not having play enough They never get far enough away from the field of force

We want more amplitude of vib. in fork

{See Pat 219,166 WJH

With plain fork with 9 cell [illegible]
we get on end of fork

24½ inches of fork	vibration	·10 of inch
17	"	·06 —
11		·04 of inch

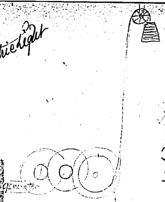
With weights when tuned up.

24½ inches	vibration	·14 of inch
17 —	—	·07
11 —	—	·045

see Pat 218,166 W.J.H

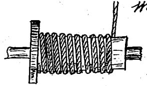
Electric Light

Dec 14 1848
Chas Batchelor



Train of Gears
generator turns 600
Weight to fall 10 feet
size of drum about 3.85
in order to make 10 feet
drop in 10 turns

Pin on drum to connect
circuit and on turning
ten times open again
Large handle for winding
Weight up again



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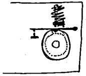
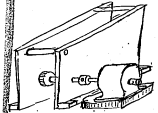
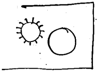
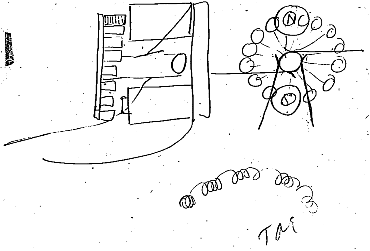







TM

Electric Light

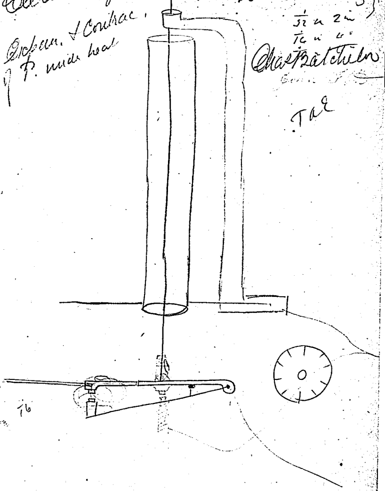
Dec 17 1878

Expan. & Contrac.
of P. under heat

$\frac{1}{32}$ in 2 in
$\frac{1}{16}$ " 4 "

Chas Batchelor

TAE

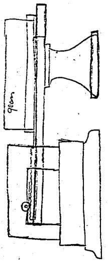


Electric Light

Dec 18th 1878

Chas Batchelor

+ CR



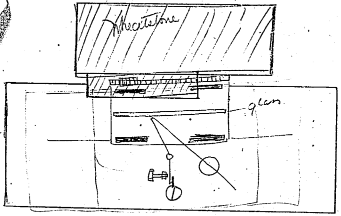
$\frac{3}{32}$ $\frac{9}{96} = \frac{2.25}{24}$

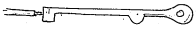
3

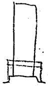
$\frac{6}{3}$

Instrument for recording heat of $\frac{1}{32}$ then 3 turns for $\frac{3}{32}$
" 24 " $2\frac{1}{4}$ for $\frac{3}{32}$
$\frac{3}{32}$ spiral

Chas Batchelor
John Ott
TAE



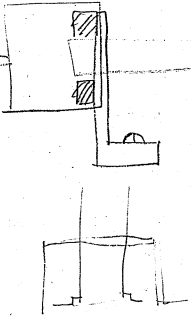




Magneto Electric Machines Dec 26 1878

Chas Batchelor

TAE

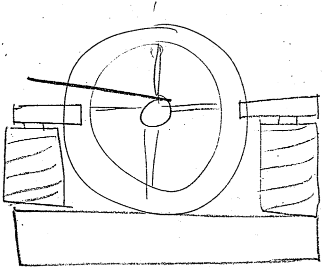


Magneto Electric Machine

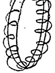
Dec 26th 1878

Chas Batchelor

TAE



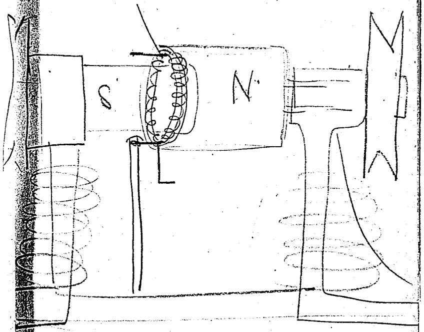
Magneto Electric Machine



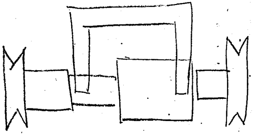
Dec 26th 1878

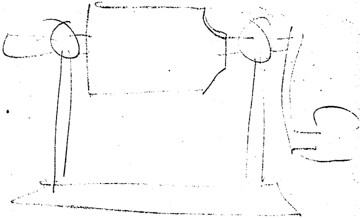
Chas Batchelor

TAE



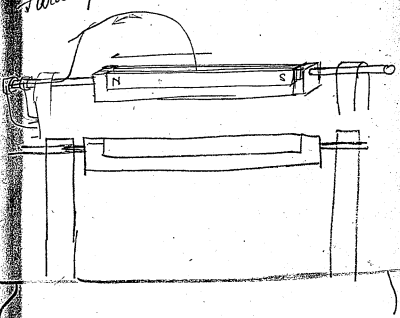
Jar

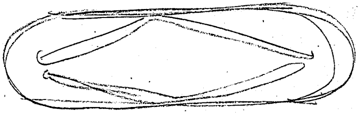


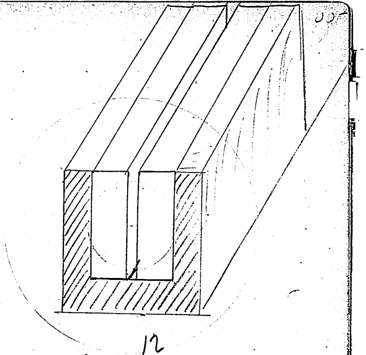


Faraday Dust

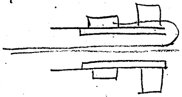
FaE

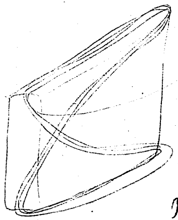






1 piece 12
1 " 4





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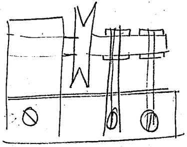

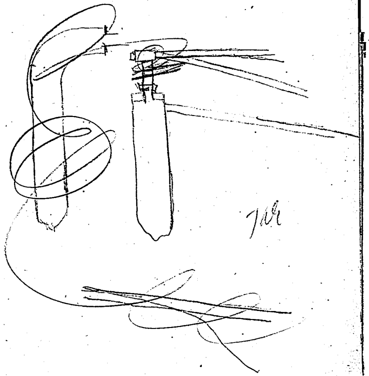
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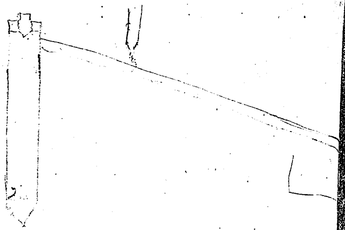
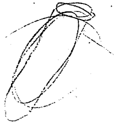




Johnson Matthey

Iridium 17·42 pr oz

Rhodium 30 6d pr oz

Aluminium did not melt in the H flame and in the O.H seemed only to oxydize without melting. Came up to incandescence without melting. When the blast of O was brought in contact it melted

Magnesium
Oxidizes too easily

Mangan. [illegible]
Cannot tell anything about it.

Boron does not melt.

Cobalt. brittle seems to stay at white heat. Melts when oxydizing at white heat. The [illegible]. Breaks to pieces under the hammer.

Nickel changes very little at white heat except to oxydize. Does not melt light brilliant. Can be pounded though cracks appear from non annealing. (as infusible as Pt) Greatest difficulty in melting it seemed to melt at about the same temperature as Pt. E

See page 66

Cerium ~~does~~ seems not changes Slightly fused. The fusion probably due to impurities of silica. E.

[illegible] and
[illegible] oxydizes

Grams went immediately

Silicon seems to volatilize [illegible] when a certain temperature [illegible]

Silicate of nickel. ~~Does~~
Nickel Silicon placed together in flame O + H. Melted but not very readily. The mass was magnetic.

Rutile oxide of Titanium fused. Good conductor very heavy [illegible] when [illegible] oxidized 17 Ohms

See Pat. 219,628

Nickel

The button was extremely hard and green when broken

Resistance of a wire 1 ft long 1 mil in diameter 75.78 Matthiessen

Resistance of wire 1 Metre long 1 mm in diam. 1.071 Nickel annealed. This is about 1/3 greater than Pt.

Wright Vol. 13 Amer. Jour. Sci. P. 52 obtained a thin film in a tube which in transmitted light was gray or brownish gray. The removal of O was not complete.

Nickel

The button under the microscope was insulated by what seemed like lime. no metallic color be discovered

Lasimeter No. 1,
Patrick & Carter

29	R	100
25	L	50
20	L	25
15	L	0
10	L	100
5	L	170
10		Off

~~10~~ 5	R	+ 270
10	R	220
15	R	280
20	R	280
25		200
30		1.00
35		125
40		−150
45		Off scale

40 L — off

35 L — off

~~[illegible]~~

shaken the

0 Rt 0

25 — off

20 — off

15 End

10 — End

5 — End

6 — End

95 — L — [illegible]

90 — 125

85 — 125

80 — 0

Changing

68 + 125

62 + 180

50	R	— 170
45	L	— 150
40	L	— 140
35	L	— 140
30	L	— 140
25	L	— 140
20	L	— 135
15	L	— 135
10	L	— 130
5	L	— 120

0	L	— 120
95	L	— 115
90	L	— 115
85	L	— 115
80	L	— 110
75	L	— 105
70	L	— 100
65	L	— 50
60	L	— 35
50	L	+ 45

50 L		+140
45 L		+230
40 L	off	+360

---

45 R	+360
50 R	+355^{5}
55 R	+345^{10}
60 R	+345^{0}
65 R	+340^{5}
~~70~~ — R	+337^{8}
75 — R	+335^{2}
80 R	335^{0}

85 R	335^{0}
90 R	335^{0}
95 R	335^{0}
0	331^{0}
5	335^{0}
10 R	+ 300^{35}
15 R	+ 285^{15}
20 R	+ 250^{35}
25 R	+ 208^{30}
30 R	170^{30}

Nov 1.

35 R + 130 15

40 R + 45

45 R R — 45 91

50 R — 140 95

55 R — 225 93

60 R — 300 125

Tasimeter made in shop 50 Divisions

~~[illegible]0 R~~ 30 turns

30 R — 150

25 L — 132

20 L — 100

15 L — 75

10 L — 55

5 L — 40

0 L — 30

45 L

40 L — 30

— 20

78

35 L — 5
30 L + 5
25 L + 40
20 L + 80
15 L + 130
10 L + 200
5 L + 305
0 L Off

45

79

O	L	Off
5	R	"
10	R	"
15	R	"
20	R	"
25	Off	
30	Off	
35	Off	
40	Off	
45	360	
50 +	335	

5 + 220
10 295
15 235

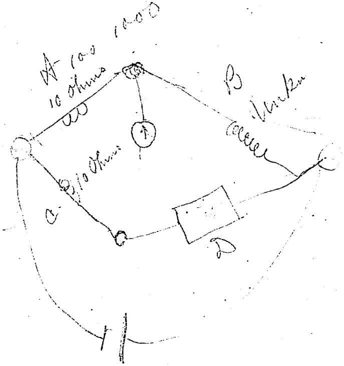
20 R 145
25 R 130
30 R — 175
32 — 250
33 — 275
34 — 325

The same
~~R~~ 7 ½ L just off the scale
20 R
25
30

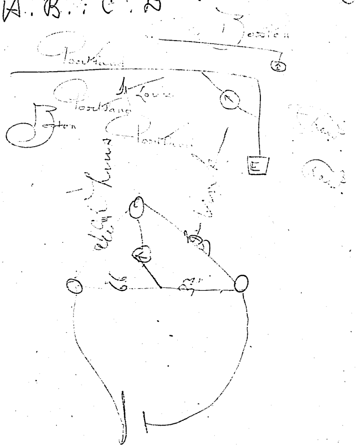
15 with next shot appears

L5 350
0 270
5
10 150
15 R 100

25 -- 30


A 100 1000
10 ohms
B
C
10 ohms
D

A:B::C:D


Boston
Portland
St Louis
Portland
Boston
Portland
E

8

No. 1.

~~One the~~ Otie turn flag in the view.

from 19 Ohms to 1/4 Ohm [illegible] button

No. 2 10 Ohms resistance

95	R	320	
90	L	290	30
85	L	+235	45
			45
80	L	170	
			30
70	L	60	
			55
65	L	5	
			65
60		−60	
			95
55		−155	
			95
50		−250	
			85
45		−335	

the O f C

50 R	-320	
55 R	-250	70
60 R	-190	60
65 R	-120	70
70 R	-70	50
75 R	-15	55
80 R	+42	57
85 R	+97	55
90 R	+142	55
95 R	+210	66
0	+265	55

---

5 +320

No. 1 New carbons

11 Ohms to 1 Ohm

tested on one Ohm and found that the slightest change of the screw would throw the spot off the scale.

very little play in screw and none when sensitive at both 1 Ohm

---

About 80 divisions play when the R = 4 Ohms and Galva. doubly shunted.

No. 2

80 divisions play 9 Ohms
Galvanometer shunted

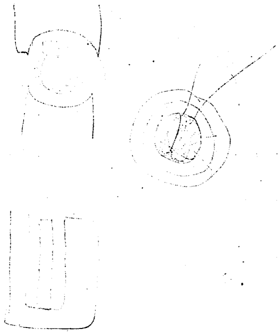
from 17 Ohms to .7 Ohm
60 divisions + 1 Ohm

Instrument made
have very little play
and very sensitive

No 3 no play
very good

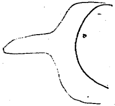
~~No~~ Tried again with a
shunt on Gal and found
80 divisions back lash

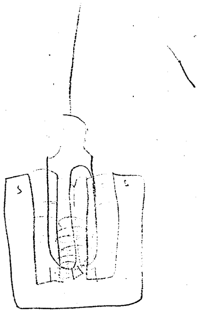
90

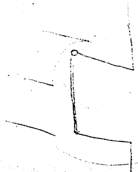


91

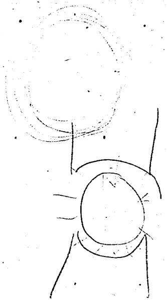
Pages 90 to 97 incl. "Dynamo Sketches."

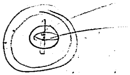


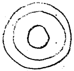


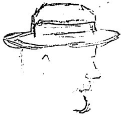


ohe



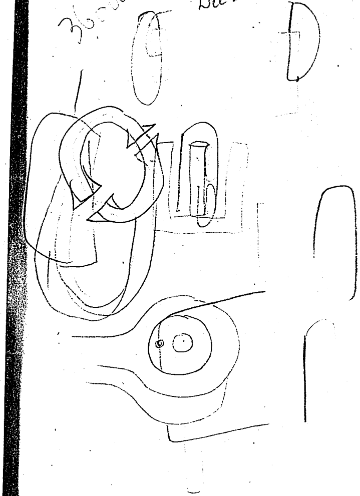




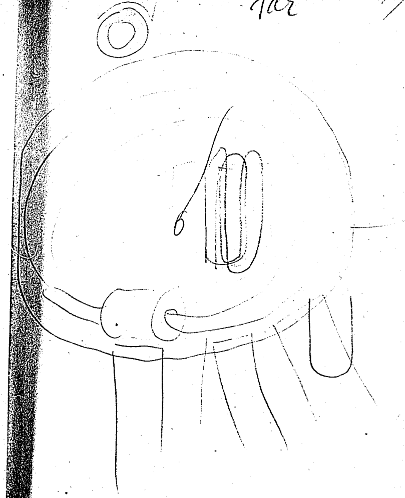


36000.

Dec 25 [redacted] 1898 [illegible]



Tae



Colloug per gramme

Th.-Cl. per gram .198547

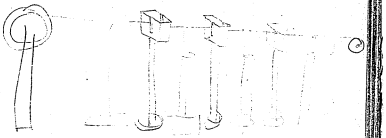
Log $\bar{1}.297798$

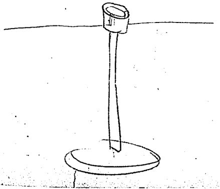
7000 3.845098

3.14289

TAE

Wire drawing, While heating Wire. Page 101.





11.

17

8

8

24
8
192

60

60

56

60

192)3360(16
192
1440

24 56

$$\frac{8 \times \overset{9}{\cancel{24}} \times 3\cancel{4}}{\underset{10}{\cancel{60}} \times \underset{13}{\cancel{52}}}$$

240
24
160

$$\frac{8}{13}$$

8

36 on shaft

0

$$\frac{24}{60}$$

42

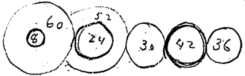
$$\frac{36 \times 30 \times 24 \times 8}{11 \times 42 \times 52 \times 60}$$

180
8
1360

$$\frac{\overset{6}{\cancel{36}} \times 30 \times 8}{11 \times \underset{7}{\cancel{42}}}$$

$$\frac{1360}{77}$$

77)1360(17.2
77
590
569
210


8
60
24
52
30
42
36

~~24~~

8 X 24 X 36

~~10~~ 5

~~0~~ 8 X ~~60~~ X 52

~~24~~ X ~~36~~

6 3   63

9)160 (17

9

70

~~44~~ 7 13 ~~10~~ 5

~~42~~ X ~~52~~ X ~~60~~ ~~300~~

~~36~~ X ~~20~~ X 24 X ~~8~~

~~16~~ 3 ~~4~~

35

13

105

35

24)455 (18

24

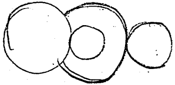
215

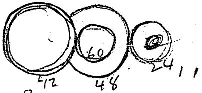
193

220

8X36

288




60
12
48
24
11

8

8

8

36
36
60)396
66

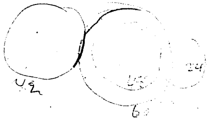
8
―――
2

33 48
11

24 48 60 42

13 2
8 X ~~60~~ X ~~40~~
―――
~~60~~ X ~~30~~
~~30~~
10

13
8
―――
104



No 25 wire
2.72 Ohms

132 turns

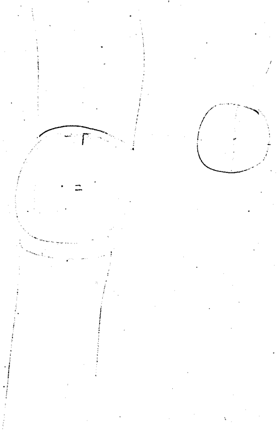
132) 2.72 (.02
2621
80

500
272
2)228
114

132
114
18

17
12
132

12
8
96



100
12

1047
3
.131
1100
131
.131
144.1100

1100

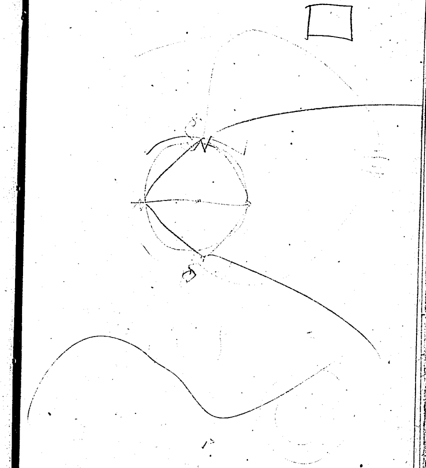
288 inches

28.8
14.4
7.2

[illegible]

200°
62°
138°

1380°
2760
[illegible]
5520°



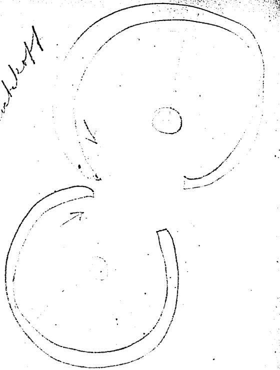
+ 20 Ohms 2½ No 30
10 Ohms
10 Ohms
5 Ohms 2 spools No 25
2 of 2 Ohms 1 spool No 2
2 Ohms
1 Ohm 1 spool No 20
.5
.2
.2
.1

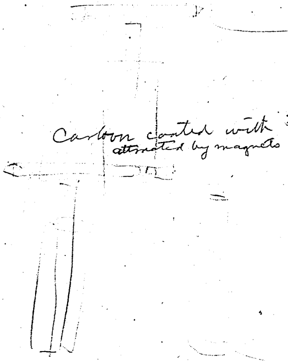
No. 30 Wire

3 spools 20 Ohms
~~No. 24~~

5 Ohms 20

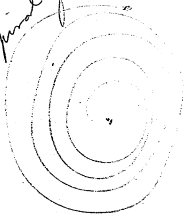
2 Ohm 1 spool No 23


Curved Jablochkoff


Carbon coated with Fe - attracted by magnets

TAE

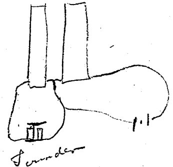
Spiral Jablochkoff



March 12

The discharge from a magnet measured

A sounder was placed thus

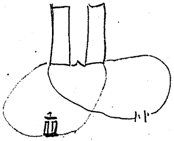


A [illegible] click could be heard when the current was taken off

TAE

2end method

TAE



Double click could be heard when current taken off

2nd method

A duplex point was used to break the main circuit and the discharge thrown through the sounder

Results when no armature was on the magnet the discharge was ~~very~~ stronger ~~and~~ sharper and of shorter

124 ter duration than when the armature was on.

125

Pages 125 to 153 incl. "No importance."

For cores 4.03 Diam 90 inch long

677 ft of No 8 wire =

" 11 Birm. gauge

= 0.45 ohms

314

53~~75~~

942

1570

16662

6.

99.972

403

314

1612

404

1209

12.6552

90

1139.50

7.03

128 90000

896

400

256

144

14)90000 643

84

60

40

1265

703

3795

643

314

2572

643

88550

741929

12

889295

12)20.19.02=168.

1500 6770=.45 49

7700

12

1265

81

99

30

643

3795

5060

1590

12)8133.95=677

15000

1354

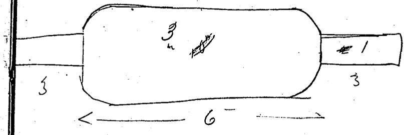
146

93

93

lbs.

2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
4
2
4



63 m 10 sec 10

1 lb at 10 inches

678
5
3380

10
3.14
12) 31.4
2.6

381
331
381
1143
11711

1/2 lb.

63.
6
378.
5
1890

127.
3
381

30

20
3.14
6.28.
2
12.56

1256

3.14
40
12) 125.6.0
10.4.5
3
31.2

20 inches

40 inches

20

12 | 60

5

~~120~~

10 feet

3

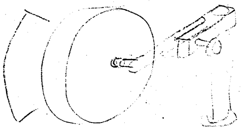
30 foot lbs

381

30

10,430

Tak



9 1

20 inches radius
40 inches diametre

40
3.14

$$\frac{\overset{10}{\cancel{40}} \times 3.14 \times \cancel{7} \times 381}{\cancel{12} \atop \cancel{7}}$$

~~381~~
~~3.14~~

381
3.14
1524
381
1043
10,963.4

10,963.

Batch 10.963 ft. lbs
20 seconds Test

Francis 16.846
10 seconds 15.225

Martin 14.100. ft
20 Sec -

Geo Carman
14.106 ft lbs
20 Sec

Albert Swanson 17.191
15.750

Times. 15.759 14445

97
6
582

2 291
3 × 18.5 × 2 × 3.14 × 582
12
4

291
3.
873.
18.5
4365
6904
873
16,070,5

18,5
2
37.0
3
12 | 111
9 1/4

18.5
2

9.25
3
27.75
97
× 97
19425
24975
2691.75
6
16.146

5 . 1/2 .

171
5
855
85
940
5
4700 3
00
14.1

27.5
171
27
189
27
4617.0
4697

28.15
171
2815
28.15
19705
4813.65

11.25 Radius, Diam 22.50

Rev. 171

Weight 5 20 Sec

22.50
5
12)67.5
5.63

$\overset{lb}{5} \times \overset{ft}{5.5} = \overset{ft\ lbs}{27.5} \times 171 =$

4697 × 3 = 14.091

$\overset{lb}{5} \times \overset{ft}{5.63} = 28.15 \times 171$

4813 × 3 = 14.439

Geo Carman

Weight 5

Revolution 171

Radius 11' = diam 22

22'
3
12/66
5.5
5
27.5
171
275
1925
275
4702.5
3
141.06

5.5

Swanson

Rev. 210

Height 5

Radius ~~105~~ - ~~19~~ 20

20
3
60 ~~19~~ ~~3~~ ~~57~~ 4.75
3
210
1050
5
5250
3
15750

Kruesi

191 Rev.

11 Rads 22 Diam

5 ll

5.5
191
955
955
1050
5
5250
3
157.50

22
7/66
5.5
5
27.5
191
275
2475
275
5252.5
3
15757

Rhus

21.4

9.m Rasins – 18 Dram

5 h

3
154
4.5
21.4
8.5.6
1.07
9.6 3
1. 5
4.8 1.5
3
14.4 4 5

Swanoos

Height 5

Rev. 191

Radius 12 = Dia 24

3
10 / 72
146
191
1146
5
5730
3
17191

Weight
Rev. 203
Radius 10 —
5

20
10 | 60
5
203
1015
5
5075
3
15225

15

This battery has now been ~~shortcircuited~~ put on 100 ohms, 13 hours out of 48 hours —
We now connected to Bergman bell on 100 ohms and

May 11 11 AM worked well
May 11 6 PM worked, OK
May 12 7 am worked well
" " 1 PM worked OK
" " 8 PM ~~All right~~
13 8 am all right
13 6 pm OK

9 30

May 9th 1879 155

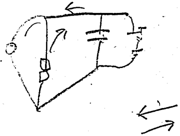
Call Battery

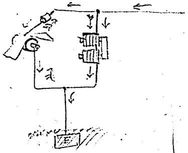
Chas Batchelor
M. N. Force

Tests on 100 ohms,
10 Couple Leclanche - Galv. Shunted

Put on	Deflec.	Taken off	Deflec	Total time on	Off
11 AM.	67	12 n	65	1 hour	
1-30 PM	67	3:10	60	2-40	1-30
4 PM	65	7'50	50	6-30	:50
10 20 PM	53	11 PM	49	7.10	2.30
8-30 am	50	10 AM	35	8.40	
11 AM	41	12 n	32	9 ~~50~~	
12-30 PM	35	1.50	30	11, ~~[illegible]~~	
2.35 pm	33	3.35	26	12 —	
10.15 AM	42	11-15	27	13	

See other side





Birkey May 10th 1879 M. N. Force

Call Battery No 2. Tests on 100 Ohms
10 Couple Leclanche-Gasshunter
1/2 Carbon 1/2 Hyperoxide Mg

Put on	Deflec	Taken off	Deflec	Total time on	Off
2.23 P.M	57	2.35	50	7 m	1 hour
3.35	32	3.45	45	0-10	1
4.45	50	4.55	43	-10	17
10.3 AM	55	10.13	36	=10	3
1 PM	47	1 10	34	<10	76
13th May 5 p.m.	41	9 PM	15	4.00	
14th May 12 noon	rings bell through 200 ohms				OK

May 15th 1899

Batteries

No 3

100 ohms resistance always

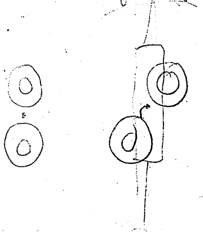
13 couples Zinc + Carbon

layer of NH_4HCl: $\frac{1}{16}$ thick

2 thicknesses of blotting paper saturated with NH_4HCl

Time	Off Date	Deflec	[illegible]	Total time on		Total off	Remarks
2.33	15th May	68°		56			
3 ~~55~~		63		54			
4 35	—	58 —	—	—	—	— — —	Taken off [illegible]
6 PM	rings bell	perfectly	through		200	ohms	(Batteries)
8 PM	" "	" "					
10 " "	" "	" "	"		200	"	G.E.C.
7.30 AM	16th May	" "	"		400	"	G.E.C.
2 " "					400		M.N.F.
11.30 PM		weak	— —	=	400	"	G.E.C.
7.30 AM	17th will	not ring	through		400	"	G.E.C.
1.30 "	very	good	on		300	"	— —
3.15 "	"	"	"		800	"	" " "
5.40 "	rings	through			400		
7.30	"	—			400		
"	"	"			400		—
8 PM	"	"			400		

See page 175



May 15 1879

Batteries No 4

10 candles Zinc & Copper with layer of [illegible] & [illegible] [illegible] solution & [illegible] suspension about 1/32 in thick on carbon, then 6 sheets blotting paper soaked in sol Sal Ammoniac

Put on
10 PM ring bell through 200 ohms perfectly GEC
7.30 AM 16 May " " " 400 " GEC
2 PM rings bell perfectly through 400 ohms M.N.F.
11.30 " " weakly " 400 ohms GEC
1.30 AM 17th May " very weak " 400 " GEC
3.45 " " " " " 400 " " "
6 " ring pull through 400 " "
8 " " " " 400 " "
10 am " " " 400
5 PM " " " 400
18th May 4 PM. OK on 400 ohms.

See page 179.

G.E.C.

Battery No 5 — May 17-79

11 couples Zinc & Carbon with 6 sheets Blotting Paper soaked in Saturated Solution Muriate Ammonia and [illegible] square 2 [illegible]

12 [illegible]

4.20 AM May 17th

Ship bell through [illegible] resistance not strong — GEC

6.40 AM ringing strong 600 ohms " "

8.30 " "

10 AM " " " " " CB

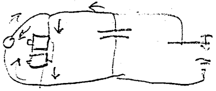
[illegible] — GEC

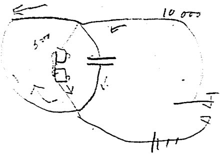
taken off 4.30 PM May 17 and ~~sent~~ taken to Bergmann & Co N.Y. By TAE & CB..

Brought Back and Put on 20th at 5.30 PM.

Stops ringing 1 PM on 2[illegible]

GEC





No 6 Battery May 17 79

Eleven Boxes Carbon & Zinc with paper blotting paper soaked in Sulphuric acid 1 part to 12
GSC

5.30 PM ok on 200 Ohms. GEC
May 18 4 PM OK on 400 ohms — CB.
May 19 12 PM OK on 1000 GEC
" 23 Ran on 100 Ohms after standing open for 4 days and will not ring Bell

G E Carman

Telephone May 17 1879

Chas Batchelor

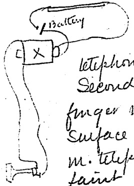
tal
Made a button for transmitting of
Sulphide of Copper.

It was just about one half as loud
as our regular button

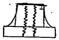
It's articulation was very perfect

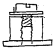
Its best talking was done when
it measured 9 ohms resistance

A piece of Sulphide of Copper measuring 37 ohms was put in primary circuit of coil X, and telephone receiver connected with Secondary. Scratching with finger nail or knocking on surface of Sulphide can be heard in telephone but exceedingly faint.



Domestic
Domestic
Do





Battery 3

May 18th 4 pm. rings perfectly on 300 ohms
May 19th put on 100 ohms and closed every
hour 752 times at 5.30 p m
taken off at 6 and put on again
at 7 P.M. left till 10 P.M.
[illegible]
[illegible] after [illegible]
having rung the bell 3750 times
11 [illegible] 300 [illegible] I have put on
[illegible] through in very good
Started 7 [illegible] May 25th 1899
with 100 Ohms resistance
[illegible]
[illegible] 10 [illegible] 12 then off
hour commenced at one [illegible]
30 then taken off until 7 pm

May 27th 9 am put on bell but it would
not work it

198
145

3000.

4½

3

30

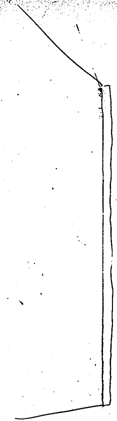
300

3

16.

Mac 3/4.

1	Mac ½	– LW ¼	– 30 lamps	16
2	¼	– 1/8	60	8
3	.12½	– .06	120	4
4	06	03	240	2
5	03	01½	480	1
6	01½	07½	960	½



continued from page 163

Battery No 4 May 19th

5.30 PM Put on clock [illegible] and connected with main Shaft in Shop Made to ring 352 times Per hour through 100 Ohms — taken off 5 minutes

[illegible] PM May 19th ring through 300 Ohms

May 27 8.30 a.m. put on bell ringing through 100 ohms by shaft

Battery No 7 G E Carman

11 cells [illegible] 6 [illegible]

[illegible] 1 [illegible]

[illegible] 3 parts [illegible] 1.30 PM

[illegible] 752 lines per hour

[illegible] through 700 ohms resistance

[illegible]

Taken off 3.30 PM for ½ hour
and internal resistance
increased [illegible] to .20 Ohms
put on at 4 P.M. stopped from 6 to
7 PM) started at 7 PM [illegible]

[illegible]

May 21
started 7 AM
Run till 10 PM   May 22nd 1879
started 7 AM — on 100 Ohms resistance.
run till 11 PM   See Page 185

Raking [illegible] 7 [illegible] O.C.

May 25th 1879

[illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] Soaked in Sol Sulph
ʒß to O4 water
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]

Carman

from Page 181 G E Carman

Battery No 7 — May 23rd 1879

Has rung 21 hours 752 Pr hour 15.792 G E Carman

Started on 100 Ohms resistance at 9 A.M. Chas Batchelor

ring on 400 Ohms =

taken off 11 PM having run 14 hours total

running time — — — — 36 hours

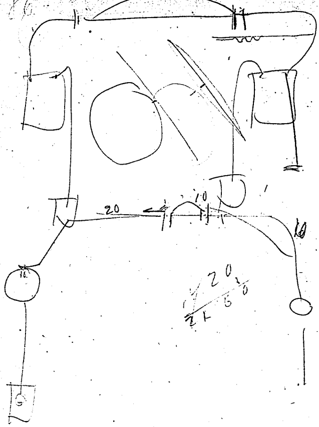
run May 24 — — — — 9 hours

45 hours

Making 752 strokes pr hour makes 33.840 strokes

Saturday 5 P.M.

May 26 Monday Put on at 9 A.M.



May 29th 1879

Battery No 9

Chas Batchelor

9 couples: Carbon & Zinc
6 papers wet with Chl Ammo

Put on at 1 PM May 29 1879
and it rings through 100 ohms good but it wont
through 200.

taken off ~~3~~4 PM called 2150 times

Total time Made	on	off	calls	total calls
3 hours				~~27~~ 2150

Bat: No 90 Batchelor

Put on 4pm 29 May 1879
ings through 100 ohms

Battery G S Cannon

No 11 May 31st 1879.

9 couples Carbon & Zincs with
Six Layers Paper in Sol Sal Ammon
and water Equal parts
½ inch Smaller than Carbon plate
run through 100 Ohms Resistance

June 2d 10 AM rings now only on
short circuit

GE Carman

No 12 Battery May 31 1879

9 Layers carbon & Zinc taken from No 5 and cleaned set up and rings through 300 Ohms - formerly rang through 600 " weakly

June 2d 10 AM rings weakly on 200 ohms

G E Carman

No 13 Battery May 31st 1879.

6 cells Carbon & Zinc Strips in Solution Sal Ammoniac And water Equal parts rings through 200 Ohms Resistance

---

June 2nd wont ring owing to corroding of copper at point of contact of wires

Make another —

— G E Cirman

Battery No 14   May 21 '87

9 Layers Zinc & Carbon
Carbon soaked 14 hours in
Electropoin then washed and
boiled in paraffine
rings through 500 ohms resistance
at 3.20 PM through 400 at 4.20 PM

George

Make a battery of Carbon and Zinc with 6 sheets of paper between. Amalg.

4 Sheets next the carbon to be soaked in solution of 1 part ordinary bichromate solution and $1\frac{1}{2}$ parts water

2 Sheets next the Zinc soaked in weak solution of Sulphuric acid & water

---

Make a battery of Carbon + Zinc and between them, put a layer $\frac{1}{32}$ thick of Sulphate of Mercury on the carbon Then put 2 sheets paper soaked in Solution SO_3 (12-1)

Make bottle battery 10 cells like other one but weak solution of Bichromate in Amalgamate Zinc

---

Make bottle battery 10 cells like above but weak solution $SO_3 + H_2O$
Amalg Zinc

Make battery of 10 bottles of Zinc + ~~Carbon~~ Copper (no amalgamation) fill bottles with solution of Alum (concentrated)

Make up Sal amm bottle battery again making good connec. & paraffining them

---

Make bottle batt. of Amal Zinc an Carbon in Bichrom + H_2O 12+1 and let Zinc stand in Hg at bottom of jar

---

Battery No 15 June 2d 1879

9 cells Carbon + Zinc (Carrey).
(6 sheets paper 4 soaked in Elect^n / Water 1½ and 2 soaked in SO_3 very weak

---

10 AM Rings at first through 100 ohms but after five minutes it would ring in short circuit

Battery 16 June 2d 1879

16 Bottles containing amal. Zincs and carbons in Solution of Bichromate 1 to 6 H_2O

10 AM June 2d 1879 rings through 800 ohms.

10 am June 10 1879 rings through 125 ohms

Battery No 17 June 2 1879

10 Bottles Amalg Zinc and Carbon in Solution of $SO_3 + H_2O$ in prop. of 12 - 1

---

10 AM June 2 1879
rings through 500 ohms good
11 AM June 10 1879 300 ohms good
" "

Battery No 18 Chas Batchelor June 2-79

10 Bottles Amalg Zinc and carbon
in Electropoion 1 Part water 12
with Mercury in Bottom of bottles

3pm June rings through 400 ohms good

made | goes through | date |

10 AM June 10 played out carbons
corroded at connections

Battery No 19 June 2 1879

Chas Batchelor

10 Bottles Zinc x Copper in
Saturated Solution alum
Rings through 200 Ohms

3 pm. June 2.

Made	rings through	Date		
	200 ohm	june 2	3pm	
June 9	1879 played out			

June 2 1879

Battery No 20

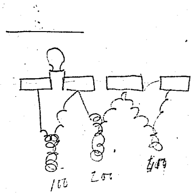
Chas Batchelor

Zinc & Carbon

no 6 1/32 Sulph Mercury and 2 sheets paper wet with SO3 and [illegible] 12 to 1

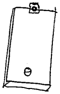
Rings through 300 ohms at 2 PM

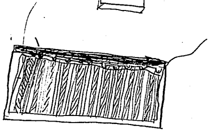
How long	rings through	on	
	300 ohms	15 ohm	2 pm June 2
6 hours	500	15 ohm	8 pm "
20 hours	400	15 ohm	10 AM " 3

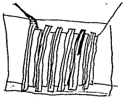


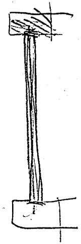
Battery June 5th 1879

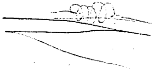
No 21. Same as no 20 6 made
Ring through 600 ohms











1/2 diameter

1/4 section

4 times length or convolutions

16 times resistance

m 1/100 16 times resistance

1/100

1/10'|

$23 worth of wire

~~goes~~ take 1/10 of H.P to run

it it. $3.65 a year

$7.00 a year

2.30

$9.30

36.5 1,5623

23. 1.3617

23. 1.3617 2,72234

4.1857

$a = \frac{15330}{2}$ .3010

3) 4,4867

[illegible]

1.4956

~~$[illegible]~~ $31.2

Let x = cost of wire

And y = cost of H.P. principalized for magnet

$y = \frac{a}{x}$

$yx = a$

$y = \$36.5$

$x = \$23$

$y + x =$

$\frac{a}{x} + x = \text{min}$

$a = 15330$

$a(x^{-2})$

$-2a(x^{-3}) + 1 =$

$-ax^{-2} + 1 = 0$

$x^{-3} = \frac{1}{2a}$

$2a = x^3$

$x = \$31.20$ ~~max~~

2cts. an hour

$X = \cancel{7}\$23$

3.65
2
$\$7.30$

$\log X^2 = 2.7234$

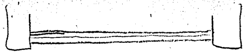
$\$73 = y \quad \log 2 = .3010$

3.0244

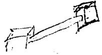
2.7234
1.8633
$\cancel{4.5867}$
[illegible]

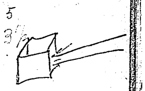
3.1244
1.8633
4.8877
1.6292

~~$42.5 H.P at 2cts an hour If ten magnets per H.P. will furnish power enough with the magnet of machine as now built $42.50 may be spent so as to bring 10% on a machine used ten hours a day.~~



x = length
y = Diameter





Mass of iron axy^2

Cost iron bxy^2

Cost Cu. cxy

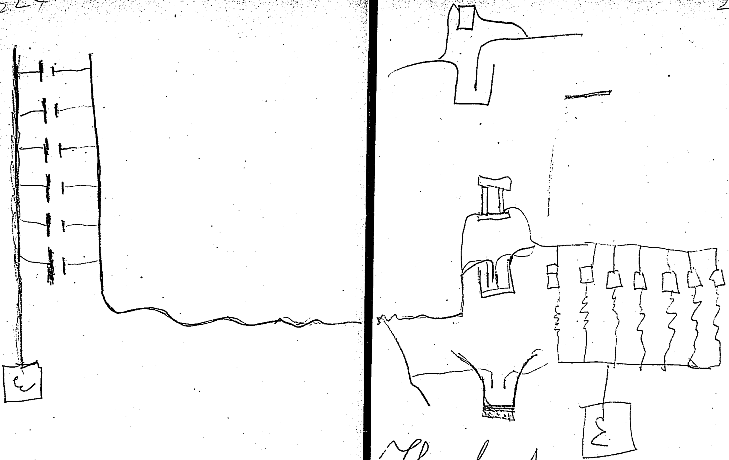
Efficiency Cu.

52
30
1560

52
156
364

$\sqrt{x}\,\sqrt{y} \quad axy$

$(bxy^2 + cxy)$



The lamp

6 per H. P. July 8

1/2 ct an hour each
for H. P. Cost including
allowing for loss

cost and repairs of engine
and boilers as delivered to
Dynamo machine

20 lights $100 dynamo
Gas $200

$5
$5
$5
$15

$150

1/2 ct a day

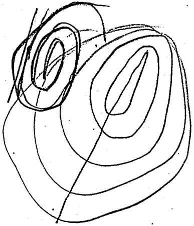
interest for capital

lamp Each light must
burn on a average 7 hours

Suppose 1/2 Ohm machine
as compared to 1 Ohm
2 times the wire to make
it equally ~~[illegible]~~ = efficient
with same current

1/2 Ohm as compared
with 1 Ohm

To the wire the same
current has



4 Ohms same wire

4000 turns
4000 Ohms
4000
1 Current

4000 Cut

4 Ohms
1

~~1.18~~
1.19 Bridge
1.16 Slide

9
56) .9.0 (16
56
340
336
4

230

~~[illegible]~~

magnets

24 hours a day

3.65 1ct an. hour
24
1460.
730
8760 $876

1H. P. on magnet
~~[illegible]~~ cost of magnet

$\log 2x^2 = 3.0244$
876 2.9425
3)5.9669
1.7889
.3617

$97.50

231

$7.50

1/2 Ohm

2 times the wire same
current same no turns
just as effective
1/2 Expense

4 times the wire 2 times
the no ~~turns~~ 2 times the resis-
ta~~[illegible]~~ the same resistance
as at first
1/2 the current twice
the strength
1/4 as expensive

2 Law

The economy of a magnet is directly proportional to the weight of Cu. on the magnet ~~if~~ the current be ~~arranged~~ ~~to~~ made to suit the resistance. For example a magnet of 1 Ohm consuming, ~~for~~ with 10 Webers of current on it, 4430 ft. lbs. of energy a minute and has strength of 10.

A magnet of ½ Ohm having the same no of convolutions, made by twice the wire, with the same

current on it, will have strength 10.

Cost 2215 ft. lbs.

A magnet of two Ohms having twice the wire or twice the no. of convolutions will ~~to strongs~~ with half the current have strength 10

cost 2215 ft lbs

Therefore it is better to buy a large sized wire as less cotton is bought and more Cu with the money!

$a = xy$

$23

$x^2 = a$

$x = y$

23.
36.50

1.3617
1.5623
2.9240

1.4620
.1505
1.6125

$29 can be expended

$41 at 2 cts an hour

1 H.P. at 1 cts

1.4620
.5008
1.9620

$91.6

Data ~~the large~~ The wire on the large magnet cost $23. If 1/10 of a H.P ten hours a day are consumed on it, ~~he~~ how much can be expended in buying wire?

$x =$ cost of magnet

$y =$ cost of H.P. [illegible]

$y = \frac{a}{x}$ $x = \frac{a}{y}$

$x + y = \text{min}$

[illegible] = min

$-$[illegible] $= 0$

$-$[illegible]

$x^2 = a$
$y^2 = a$ $x = y$

1900

1890 1842

1809.25

18085

1691

When the principal which will give interest enough to pay for the H.P. used, equals the cost of the wire then the maximum of economy will be obtained.

ten hours a day

1/10 H.P. at 1 ct. an hour $29

can be expended

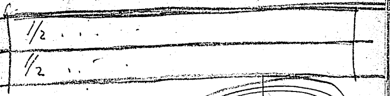
1/10 at 2 cts

$41

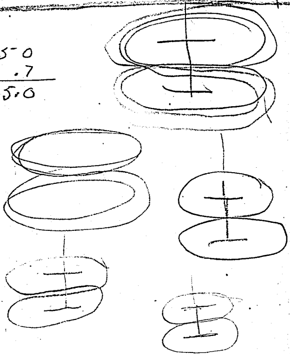
1 H.P. $91.60

15.05
.8495

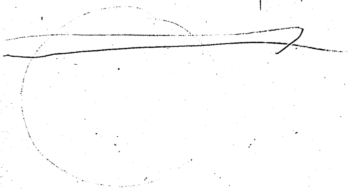
9 Ohms	3 times the [illegible]
1 Ohm	~~1~~
1/2	~~1~~1.47
1/4 together	1/2
1 Ohm	100 convo
1/2 Ohm	70.7 convo
1/4	50 convo
1/5	~~[illegible]~~

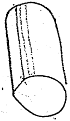


15.0
.7
105.0



1/2 Ohm how ~~[illegible]~~
much wire to weigh the
same as 1 Ohm





Jas

0 35.94 No 12 wire

1 Ohm 1 pound

1/2 Ohm 1 pound

No. 19 wire

1.09 Ohms in lbs

170 feet in Ohm

No. 18 .59 Ohms in lb.

" 116 feet in 1/2 Ohm

No 23 wir

No. 23 wire

8.74 Ohms per lb.

60.5 feet per Ohm

No. 20 wire

2.77 Ohms per lb.

4|118.5 feet per Ohm

29.6 feet 1/4 Ohm

44.3 1/2

400

17720.00

.25

.5

.5

.25

1505

8495

141.3

6990

3495

1.5227

.9613

150 Volts

550 : 1700 :: 150

701

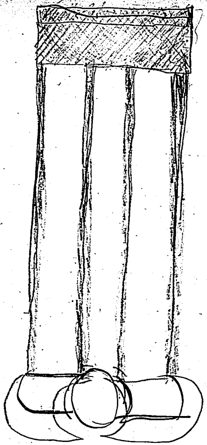
550) 1050 ohms

8.74

6.05

If an armature has 10 lbs. of Cu. on it and a resistance of 1 Ohm, with 100 convolutions

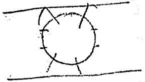
If 10 Ohms	316 Convolutions
5 Ohms	223 "
4 Ohm.	200 "
2 "	141 "
1 "	100 "
1/2 "	71
1/3 "	57.7
1/4 "	50
1/9 "	33
1/16 "	25
1/25 "	20



How can I get

1   1,4   1. $\sqrt{2}$

$$\frac{\sqrt{2}}{2}$$

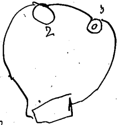


55)10500(190 Volts
55
500
495
50

~~550)~~ [illegible]

$$\begin{array}{r} 190 \\ 71 \\ \hline 190 \\ 1330 \\ \hline 13490 \end{array}$$ Volts

1 Ohm coil
5 Ohms Trans
2 Ohms battery   1/10 Ohm



8 Ohm

Current changes

7092
.2908

Change in current

$\frac{1}{8} \times \frac{1}{80} = \frac{1}{640}$

$\frac{1}{8} \times \frac{1}{640} = \frac{1}{5120}$ 1954

2 Ohms   4312

$\frac{\cancel{2}}{9} \times \frac{1}{\cancel{810}} = \frac{1}{3645}$ 2700

$$\begin{array}{r} 405 \\ 9 \\ \hline 3645 \end{array}$$

3 Ohms

$\frac{3}{10} \times \frac{1}{1000} = \frac{1}{3333}$ 3000

333

4 Ohms

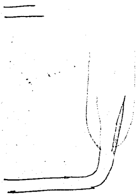
$\frac{\cancel{4}}{11} \times \frac{1}{\cancel{1210}} = \frac{1}{3327}$ 3000

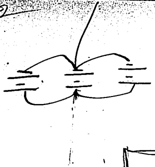
$$\begin{array}{r} 302.5 \\ 3025 \\ \hline 3327 \end{array}$$

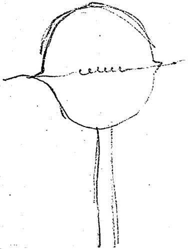
July 24th

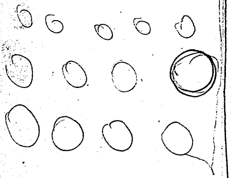
Whole line	456
without Receivers	320
Secondary & bell	161
Tertiary	350
Button (Chalk)	7700

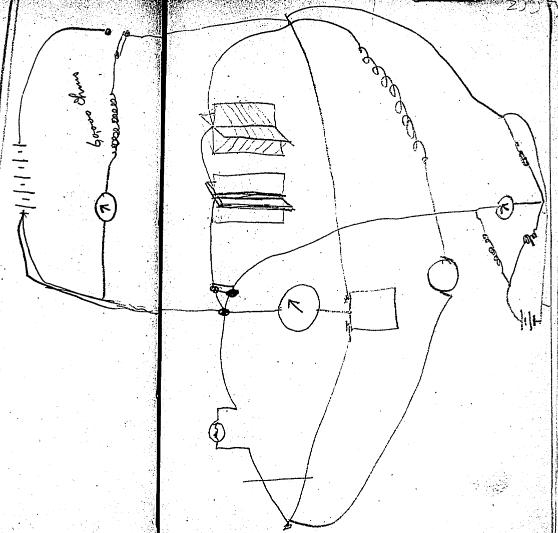
Secondary & Bell - 167

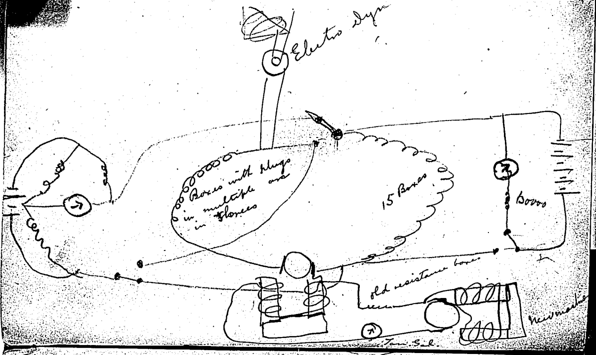


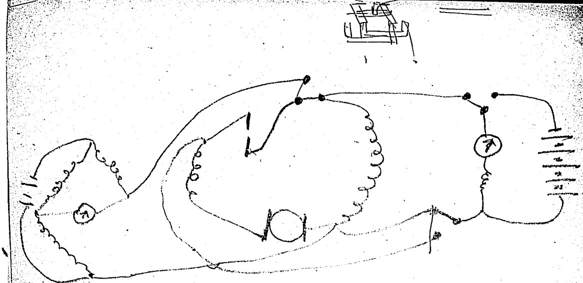


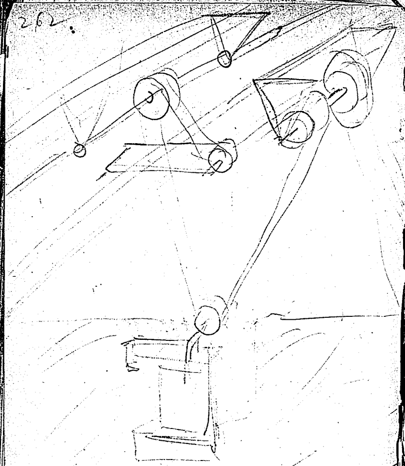




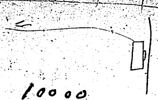

600 ohms


Electro Dyn
Boxes with plugs in multiple and in Series
15 Boxes
Boooo
old resistance boxes
New machine
Tom Sol.





10



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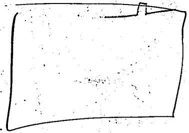

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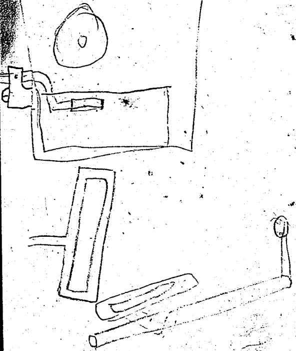325
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